The effectiveness of Bupivacaine as a pre-emptive pudendal block among patients undergoing vaginal surgeries: meta-analysis of randomized controlled trials

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Abstract

Background: Pre-emptive analgesia using pudendal nerve block (PNB) with bupivacaine is commonly used in clinical practice during pelvic floor and vaginal surgeries. However, its effectiveness is unclear. To update the evidence base we summarised short- and intermediate-term outcomes of pre-emptive analgesia using pudendal nerve block with bupivacaine as an approach in the management of pelvic floor and vaginal surgeries.

Methods: We searched the CENTRAL, PubMed, ClinicalTrials.gov, google scholar and Open Grey from inception until April 2019. The citation lists of relevant papers were also searched. Randomized controlled trials (RCTs) of women who underwent perineal, pelvic floor or vaginal surgeries and received pre-emptive analgesia using a pudendal nerve block were included. Two authors independently screened and selected eligible trials as well as performed data extraction and quality assessment. Disagreements were resolved via consensus and an adjudicator was involved when consensus was not achieved. Data was narratively synthesized, when possible, data was pooled in RevMan 5 using random effects model.

Results: Four RCTs with a total of 349 participants were eligible for inclusion. We found evidence of small effect for improvement in post-operative pain scores; requirements for opioids, SMD: -0.89 (95% CI: -1.19, -0.59) and non-steroidal anti-inflammatories SMD -1.04 (95% CI: -1.64, -0.43) in favour of the PNB versus control group. The risk ratio for adverse effects 0.42 (95% CI: 0.18, 0.99) favoured PNB. There was no significant difference between groups for length of hospital stay, MD: -0.82 (95% CI: -5.34, 3.69) and return to normal activity.

Conclusion: We found inconclusive evidence that pre-emptive pudendal block using bupivacaine may improve postoperative pain and recovery in perineal, pelvic floor or vaginal surgeries. However, due to the scant and poor quality of evidence included in this systematic review, well-designed and adequately powered RCTs that adhere to reporting guidelines and evaluate key outcomes are needed to inform clinical guidelines on the use of pre-emptive pudendal block.

Key words: pre-emptive analgesia, bupivacaine, pudendal nerve block, vaginal surgery, pelvic organ prolapse, systematic review, meta-analysis

Background

Clinical goals of early ambulation, discharge, and rehabilitation in gynecological surgery was introduced approximately two decades ago. ^[1]In the US, approximately 200,000 women undergo vaginal surgery each year due to pelvic organ prolapse (POP). The prevalence of surgical interventions for POP is projected to rise from 8% to 45% over the next 30 years. ^[2,3]Postoperative pain after vaginal reconstruction is usually localized to the posterior vulva and perineum. Dull discomfort may also originate from the region of the sacrospinous ligament and pelvic floor. Postoperative pain management is a vital element of patient care after gynecological vaginal surgeries. ^[2,4]It has gained prominence in almost all surgical fields, becoming an important fast-track approach to enhance recovery post-surgery. ^[1]Different multimodal pain management techniques are used to achieve better outcomes. Nerve block with a local anesthetic is a common technique used in various surgeries worldwide. ^[2] Pudendal nerve block (PNB) is a low-risk, low-cost anesthetic technique, used in obstetric practice to effectively reduce perineal and vaginal discomfort during repair of obstetric lacerations. ^[12]It is administered at the sacrospinous ligament and provides highly effective and safe anesthesia to the vulva, lower vagina, and perineum. ^[13,14]

Pre-emptive analgesia is also widely used in many surgical procedures such as laparoscopy, haemorrhoidectomy, penile prosthetic surgery and circumcision. ^[9–11]Pre-emptive analgesia is an intervention provided before initiating painful stimuli, which may reduce or prevent subsequent pain. A number of studies ^[5–8] have reported that using an anesthetic to block nerve fibers before trauma prevents hyper excitability in the dorsal horn of the spinal cord, which is believed to be an essential mechanism of central sensitization. Various pre-emptive treatment modalities and their combinations have been used, however adequate pain management to recommended levels have not been established in previous studies. ^[3–8] Some authors suggest that the effects of pre-emptive analgesia may vary according to the type of surgery, and particularly in vaginal surgery there is conflict on efficacy. ^[12,13]

Various gynecological procedures are currently performed under regional nerve block or with local infiltration, such as cervical cerclage, dilatation and evacuation, and perineal procedures. ^[15] The obstetrician and gynecologist is often responsible for analgesia and sedation during office-based or outpatient procedures. ^[13,14] Different local anesthetics are used in gynecological practice, including lidocaine, bupivacaine and mepivacaine. ^[15] Lidocaine and mepivacaine are short acting in duration, with onset of action typically 5 to 10 minutes and duration of action has been reported to be 1 to 2 hours. While bupivacaine is moderate in its duration of action, it has a time of onset of action of 5 minutes, a duration of 4 hours with 2 mg/kg dose up to 7 hours with epinephrine at 3mg/kg dose. ^[15,16] The pudendal nerve provides the majority of sensations and functions of the external genitals, the urethra, the anus, and perineum. It also controls the external anal sphincter and the sphincter muscles of the bladder. ^[17,18]

The high lipid solubility of Bupivacaine among other protein receptors makes it a commonly used agent for peripheral nerve blocks. ^[19,20] However, the use of bupivacaine in PNB has shown controversial results. ^[21,22] Some studies have shown positive outcomes for the effect of bupivacaine on different nerve blocks in the abdominal and perineal region. ^[9–14] However, these results do not show effectiveness when compared against minimum clinical differences in postoperative pain. ^[3,4,17,18] Pain originates from multiple points during surgery and outcomes with pre-emptive analgesia vary with different surgical approaches. ^[2,3] For pelvic reconstructive surgeries, evidence of efficacy is uncertain and important considering the rise in the number of these surgeries performed within clinical practice. ^[2,3] Therefore, evaluating the safety, efficacy and cost-effectiveness of postoperative pain management techniques that enhance patient recovery would have potential implications within clinical practice. ^[2,3] Our aim was to synthesise evidence from randomized controlled trials evaluating pre-emptive analgesia administered as a PNB for vaginal surgery.

Objective:

To provide evidence-based recommendations on the effectiveness of pudendal nerve block with Bupivacaine among patients undergoing pelvic floor surgery. We evaluated outcomes of postoperative pain, consumption of additional analgesics, adverse effects, recovery time, patient and surgeon satisfaction.

Methods

Protocol registration and search strategy

This systematic review was conducted using recommendations by PRISMA guidelines. ^[23] Details of the study protocol was registered on PROSPERO website [http://www.crd.york.ac.uk/PROSPERO/display_record.php?ID = CRD42019118890](http://www.crd.york.ac.uk/PROSPERO/display_record.php?ID=CRD42019118890), registration number: CRD42019118890.

Sources

Electronic databases of PubMed, MEDLINE, [ClinicalTrials.gov](https://www.clinicaltrials.gov/) and Cochrane Central Register of Controlled Trials database were systematically searched from onset until April 2019 using a combination of MeSH terms, keywords and National Institute of Health search filters to develop a sensitive search strategy. In addition, key words of type of participants and interventions were used to search general databases of google scholar and the grey literature (Open Grey). Search terms of gynecologic surgical procedures, pelvic organ prolapse, pelvic floor disorders, anterior and posterior vaginal repair, colpopexy, colpoperineorrhaphy, perineum or perineal surgery and pudendal nerve block or bupivacaine were then combined. No restrictions by language, date or outcomes were applied during the search process. All articles identified were retrieved and uploaded into a reference manager. See Appendix 1 for details of a search strategy.

Inclusion and exclusion criteria

All randomized control trials assessing post-operative outcomes for women diagnosed with pelvic organ prolapse (POP) during clinical assessment, who underwent perineal or vaginal repair surgery were included. The intervention was PNB using bupivacaine compared to a control group consisting of either general anesthesia alone, spinal anesthesia alone with or without injecting normal saline. Studies that compared anesthetic approaches to pelvic reconstructive surgery, for example, anterior colporrhaphy, posterior colporrhaphy, colpoperineorraphy, enterocele repair were not included in this review. Studies describing or comparing surgical procedures that involve additional laparoscopic procedures or where the procedure involved high nerve involvement like hysterectomy or laparoscopic assisted vaginal hysterectomies were excluded. In addition, studies that enrolled male participants, involved surgical interventions for obstetrics or anal disorders, or measured gluteal pain instead of perineal pain were excluded. Clinical trials delivering nerve block after surgery; using different anesthetic agents like ropivacaine and lidocaine; different routes of local analgesia; evaluating an additional operative procedure like laparoscopy or measuring different outcomes like gluteal pain were excluded. Reviews, letters, observational studies such as case–controls, cohort studies, case reports and case series were also excluded.

Study selection

All articles were transferred into a systematic review web application - Rayyan for independent screening. ^[24] The titles and abstracts of studies were independently screened by two reviewers (MR and JT) to eliminate irrelevant studies. Differences of opinion were to be resolved by discussion, when consensus was not achieved a third review author (AA) was consulted. Full texts of potentially eligible articles were then independently reviewed using the study inclusion criteria to identify eligible.

At title and abstract screening, if it was unclear whether a study evaluated postoperative pain after perineal or vaginal surgery, postoperative pain scores or primary outcomes of interest, then the study was retained for full text review. At full text review, randomized controlled trials were screened using the study eligibility criteria. Articles that evaluated bupivacaine as pre-emptive analgesia for women undergoing perineal, vaginal or pelvic floor surgery were retained for qualitative synthesis and when possible, depending on the availability of data was meta-analysed.

Data extraction

Two reviewers (MR and JT) independently extracted data from eligible studies using a standardized extraction form, designed using guidance from the Cochrane Handbook for Systematic Reviews of Interventions and piloted before use. [25] The following information were retrieved: study identification, study characteristics, such as author name and year of publication, study type or design, location, setting, inclusion criteria of the population such as age; metabolic index or its derivatives and stage of prolapse; sample size; study attrition; duration of follow-up; inception time (time between presentation and recruitment to trial); type of intervention (dosage, type of nerve block, frequency of administration and approach or method of delivery); outcome measures such as adverse effects and effect estimates [means (standard deviations) or median (ranges)] if provided; follow-up times (short, medium and long-term) and statistical analysis methods. Authors of eligible studies were contacted when insufficient data was reported.

Data synthesis

A narrative synthesis of the results of studies included was presented. When sufficient data was available for homogenous studies or there was no evidence of a major skew, data were pooled in a meta-analysis. For example, where there was strong evidence of skew in continuous data, results from the trial were not meta-analyzed but expressed in narrative format in the main text of the review.

Due to anticipated heterogeneity, meta-analysis was performed using a random effects model with RevMan 5.3 Software (Cochrane IMS). Comparisons of pudendal nerve block versus control as intervention components were considered and meta-analyzed. Mean differences (MD) and standard deviations (SD) were used to provide summary estimates for continuous measures when an outcome was reported by two or more studies using an inverse variance method to estimate the pooled mean difference. Standardized mean differences (SMD) were used when different assessment tools are used to measure the same outcome. Multiple pain assessment time points were defined as short-term for outcomes measured up to and including four weeks after surgery and intermediate term, when outcomes were measured at greater than 4 weeks after surgery. Subgroup analysis were considered for indications of perineal surgery, if there were sufficient trials. For dichotomous outcomes, we used the Mantel-Haenszel method to estimate relevant effect estimates (such as relative risk, risk ratio and odds ratio) and corresponding confidence intervals were calculated. Where ordinal data were used to measure outcomes, for example, satisfaction rates, categories were collapsed, and the data dichotomized.

Assessment of heterogeneity

Studies included in this review were inspected for evidence of clinical heterogeneity, in either the characteristics of the participants, the interventions or the outcomes. Where pooling the studies was appropriate, statistical heterogeneity between the results of different studies was examined by formally checking the results of the Chi² test, using a P value of less than 0.05 as evidence of significant heterogeneity. The I² statistic was also checked to determine the percentage of total variation across studies that was due to heterogeneity rather than chance. [25] Heterogeneity was explored using the Chi-squared test and I² statistic, with a probability value of <0.05 indicating significant heterogeneity. Findings were interpreted as follows: I² of 0% to 30%, unimportant heterogeneity; I² of 30% to 60%, moderate heterogeneity; I² of 50% to 90%, substantial heterogeneity; and I² of 75% to 100%, high heterogeneity. In cases with extreme statistical heterogeneity which could not be explained by differences between studies, the estimates were not pooled in the meta-analyses. When possible, publication bias would be assessed using funnel plots to assess the amount of asymmetry in a funnel plot.

Assessment of Study Quality

Risk of bias was independently assessed by two review authors (MR and JT) using the Cochrane risk of bias tool developed by GRADE (Grading of Recommendations, Assessment, Development and Evaluations) collaboration. The domains assessed were random sequence generation (whether the allocation sequence was adequately generated using a computer random number generator and allocation concealment, whether the allocation was adequately concealed, for example, using opaque sealed envelopes. Blinding of participants, personnel and outcome assessors, whether knowledge of the allocated intervention was adequately prevented during the study. This ensures blinding of participants and key personnel as knowledge of the intervention is likely to influence the outcomes; and whether incomplete outcome or missing data were adequately addressed or recorded.

Selective outcome reporting checks whether the study is free of selective outcome reporting when compared against a published study protocol. We also checked whether the study was apparently free of other sources of bias that could put it at a high risk of bias, for example, baseline imbalance or bias related to study design) were also verified. Each domain was scored as either low risk (criteria met); unclear risk (not sure whether criteria met, perhaps due to poor reporting standards) or high risk (criteria not met). The effects of publication bias would be considered based on available data (more than 10 studies). Sensitivity analysis was considered to explore the effects of risk of bias on the results.

Assessment of Quality of Evidence

Findings were summarized in a summary of findings table (SoF) using GRADE. Risk of bias, inconsistency, generalizability and imprecision were considered as they influence effect estimates. Evidence was downgraded for each factor from high to very low using the following guidelines: greater than 25% of the participants are from studies with a high risk of bias; significant heterogeneity is identified or if large differences in magnitude and direction of effects between studies is present; >50% of the participants are outside the target group; and single studies with <400 participants for continuous outcomes or <300 participants for dichotomous outcomes.^[26] The GRADE assessment score was downgraded accordingly when any of these factors when judged as present.

Results

We identified 926 studies that were potentially eligible for inclusion. After removing 63 duplicate studies, 863 records were screened for eligibility. 804 studies were excluded at title and abstract screening; 16 studies were included for full text review. At full text screening, twelve studies were excluded.^[27–37] Six studies included patients undergoing abdominal hysterectomy, laparoscopy with perineal/vaginal procedures or obstetric surgery^[27–32]; 3 studies were trial registrations of full texts that were already included in the review^[33–35]; 2 studies used different interventions e.g. sacrocolpopexy^[36,37]; and 1 study assessed a different outcome - gluteal pain instead of perineal pain.^[16] One study included non-eligible participants and assessed different outcomes from this review.^[31] We contacted the corresponding author of 1 study^[31] for results of the subgroup analysis of the relevant arm with no reply. See Figure 1.

Included studies

Four randomized controlled trials^[3,4,17,18] met our inclusion criteria and were included in the review. See Table 1. All studies used randomized parallel group designs providing a total of 349 women, but not all data from participants

were included in the analysis of every outcome. One study [3] reported incomplete data that was unclear and not available after contact with the primary author. All trials were single center studies, published in English, conducted in the USA [4], Lebanon [18], Iran [3] and Kuwait [17]. Power calculations for sample size were reported for all of the included studies and were appropriate. [3,4,17,18] There was significant heterogeneity between studies included in this review and insufficient trials identified to undertake assessment for publication bias.

Risk of bias assessment of included studies

All studies [3,4,17,18] reported randomly allocating participants into groups using computer generated numbers. One study [3] did not report or perform adequate allocation concealment. All studies reported adequate blinding for study participants. Three studies [4,17,18] reported adequately blinding surgeons, while only two studies [4,18] used blinded outcome assessors.

All studies [3,4,17,18] reported adequate methods for all other domains of risk of bias assessment. There was no indication of other risk of bias due to imbalance or selective outcome reporting. However, the reporting standards were poor in two [3,17] out of the four [3,4,17,18] studies included in this review. See Table 2.

PRISMA Flow Diagram

Additional records identified through other sources (OpenGrey)

(n = 45)

00

Additional records identified through other sources (OpenGrey)

(n = 45)

Full-text articles assessed for eligibility

(n = 16)

00

Full-text articles assessed for eligibility

(n = 16)

Records excluded

(n = 804)

00

Records excluded

(n = 804)

Records after duplicates removed

(n = 818)

00

Records after duplicates removed

(n = 818)

Records identified through database searching

(n = 881)

00

Records identified through database searching

(n = 881)

Identification

00

Identification

0000

Screening

00

Screening

00

Records screened

(n = 818)

00

Records screened

(n = 818)

00

00

Full-text articles excluded, with reasons (n = 12)

6 studies—used the wrong patient population (hysterectomy or laparoscopy)

2 studies—wrong intervention

3 studies—were trial registries of full texts already included in the review

1 study—wrong outcome

00

Full-text articles excluded, with reasons (n = 12)

6 studies—used the wrong patient population (hysterectomy or laparoscopy)

2 studies—wrong intervention

3 studies—were trial registries of full texts already included in the review

1 study—wrong outcome

Eligibility

00

Eligibility

00

00

Studies included in qualitative synthesis

(n = 4)

00

Studies included in qualitative synthesis

(n = 4)

00

Included

00

Included

Studies included in quantitative synthesis (meta-analysis)

(n = 4)

00

Studies included in quantitative synthesis (meta-analysis)

(n = 4)

Figure 1: showing study selection process for systematic review of pudendal nerve block using bupivacaine

GRADE summary of findings

All outcomes were judged to have low or very low level of evidence. See Table 3. This was mostly due to high risk of bias within individual studies, inconsistency in the direction of results and imprecision due to inadequate

number of participants used to evaluate outcomes. No study assessed outcomes of incomplete analgesia, systemic toxicity, hematoma formation, cost-effectiveness analysis and quality of life.

Result of meta-analysis

Primary outcome

Post-operative VAS scores at 24 hours

Three studies ^[17,18] provided data for post-operative pain but were not combined in a meta-analysis due to substantial heterogeneity. The results of individual studies showed improvement in patient reported pain among women receiving bupivacaine for PNB compared with women in the control group. See Table 4. One study ^[17] showed standardised mean difference, SMD of -2.56 (95% CI: $-3.03, -2.10$) in favour of PNB and another study ^[18] showed SMD of -0.83 (95% CI: $-1.37, -0.29$).

Data from one study ^[4] suggested that the results were skewed. The authors ^[4] reported no significant differences in post-operative pain outcomes between intervention and control groups, median of 3 (range: 0–10). One study ^[3] did not provide data for their results, even after contacting the corresponding author. The authors narratively reported improvement in the PNB group compared to the control.

Figure 2: Forest plot showing subgroup standardized mean differences in additional analgesic requirements between the intervention and control arms.

SD, standard deviation; CI, [confidence interval](#); I^2 , inconsistency test; PNB, Pudendal nerve block.

Figure 3: Forest plot showing sensitivity analysis for subgroup standardized mean differences in additional analgesic requirements between the intervention and control arms.

SD, standard deviation; CI, [confidence interval](#); I^2 , inconsistency test; PNB, Pudendal nerve block.

Figure 4: Forest plot showing relative risk in adverse events of post-operative nausea and vomiting between the PNB and control arms.

RR; Risk ratio, CI, [confidence interval](#); I^2 , inconsistency test; PNB, Pudendal nerve block.

Figure 5: Forest plot showing mean differences in length of hospital stay between the intervention, PNB and control arms.

SD, standard deviation; CI, [confidence interval](#); I^2 , inconsistency test; PNB, Pudendal nerve block.

Secondary outcomes

Requirement for additional analgesics

Three studies ^[3,4,18] provided data for assessing the effect of PNB on the requirement for additional analgesics. See Table 5a. We performed a subgroup analysis for additional analgesic requirements. We found no difference between groups for the requirement for opioids, SMD of -0.49 (95% CI: $-1.25, 0.26$) and a significant difference SMD: -0.73 (95% CI: $-1.45, -0.01$) for NSAIDs (non-steroidal anti-inflammatories) between the intervention and control groups (Figure 2). However, results of a sensitivity analysis after excluding the study by Abramov ^[4] showed significant differences in additional consumption of analgesics in favour of the PNB arm compared to the control arm. For opioids, we found SMD of -0.89 (95% CI: $-1.19, -0.59$) and for NSAIDs, SMD of -1.04 (95% CI: $-1.64, 0.43$). See Figure 3. These findings suggest that participants included in the study by Abramov ^[4] were clinically heterogeneous. However, in both cases, we found significant statistical heterogeneity between studies. (Figure 3).

Adverse events

All four studies ^[3,4,17,18] provided data that was combined in a meta-analysis. See Table 5b. We evaluated the relative risk (RR) of adverse events for post-operative complications of nausea and vomiting between the PNB and control arms. The RR was 0.42 (95% CI: $0.18, 0.99$) (See Figure 4) in favour of PNB. We found no significant statistical heterogeneity between studies.

Length of hospital stay (in hours)

Two studies ^[4,18] provided data for length of stay that was combined in a meta-analysis. There were no significant differences between mean length of hospital stay between the intervention (PNB) and control arms (See Figure 5). The mean difference, MD was -0.82 (95% CI: $-5.34, 3.69$) with no difference between the intervention or control groups. We identified substantial statistical heterogeneity between studies.

Return to normal activity (in days)

Two studies ^[3,18] provided data for return to normal activity but were not combined in a meta-analysis due to substantial heterogeneity. One study ^[3] reported MD of -0.96 (95% CI: $-1.31, -0.61$) in favour of PNB and another study ^[18] reported MD of -8.60 (95% CI: $-10.16, -7.04$).

Discussion

This is the first systematic review and meta-analysis of published randomized control trials investigating pre-emptive analgesia for perineal or pelvic floor surgery. Providing healthcare professionals with a comprehensive summary of outcomes during postoperative care of patients after vaginal surgery. In a review of over 11,000 cases by Moore ^[6], the effect of 0.25%, 0.5% and 0.75% bupivacaine was evaluated and found to be satisfactory in caudal, epidural and peripheral nerve block for obstetric, perineal and abdominal surgery. However, this review ^[6] only included case reports which are not designed to assess the effectiveness of medical interventions due to their propensity to bias.

This systematic review aimed to evaluate the effect of pre-emptive analgesia using bupivacaine as a PNB on pain relief, additional analgesic requirements, adverse events, length of hospital stay and return to normal activity. The concept of pre-emptive analgesia in vaginal surgery aims to use local infiltration for nerve block to reduce pain from the surgical wound in the form of a pudendal block or para-cervical nerve block. After vaginal reconstruction,

post-operative pain is frequently defined as pain in the posterior vulva, perineum, and pelvic floor and infrequently as a perception of pelvic cramps. [20–22] Effective anesthesia to the vulva, lower vagina, and perineum is usually achieved by pudendal nerve blockade. The results of our meta-analysis showed small benefit on pain levels using PNB, although the evidence is of low quality and studies were clinically heterogeneous.

Pudendal nerve block in vaginal surgery has been used in a diversity of methods and clinical trials. [30–33] to decrease postoperative pain and use of postoperative opioids (Table 5a and 5b). Bupivacaine and ropivacaine are local anesthetics that have shown effective and efficient analgesia in vaginal surgeries, although most of these studies describe bupivacaine as well. [19,20–22]

In this review, clinical trials on vaginal reconstructive surgeries evaluate pudendal block for pre-emptive pain control and showed the most consistent effect. [4,17,18] Pain scores were reduced for 24–36 hours by the analgesic effect of pudendal block using bupivacaine. The study by Rouholamin et al [3] reported significant differences in pain within 48 hours when participants who underwent anterior and posterior vaginal wall repair received pudendal block compared with the control group. [3] However, the trial by Abramov and colleagues showed contradictory results [4]. This is probably due to the lower dose (50–75 mg bupivacaine) of local anesthetic compared to the other trials [3,17,18] that showed better effect on pain reduction and postoperative analgesic requirements. This might have also resulted in an insufficient blockade of the nociceptive stimuli in the visceral afferent pain fibers during pelvic floor surgery. Furthermore, the study by Abramov [4] used a heterogeneous group that may underscore the change observed. Patients undergoing pelvic reconstructive surgery were included in the study. However, in the absence of hysterectomy this approach may not be painful enough to produce a noticeable difference between the groups [4].

The trial by Ismail and colleagues [17] examined the effect of pre-emptive analgesia applied through different methods for posterior colpoperineorrhaphy. The authors [17] used a pre-emptive nerve stimulator guided by bilateral pudendal nerve block and found improved pain relief and reduced opioid use in the intervention group. The trial reported shorter time to return to normal activities compared to the control group and higher patient as well as surgeon satisfaction. In the trial by Khalil and colleagues [18], pudendal nerve block for postoperative pain management with nerve stimulator guide showed statistically and clinically relevant results on the first and second postoperative days (P values = 0.005 and 0.004) among patients undergoing anterior and posterior vaginal wall repair. [18] However, it is unclear the exact dose of analgesics, the best technique and procedure that would result in superior outcomes.

Overall, there was lower total analgesic consumption, shorter duration of recovery and greater surgeon and patient satisfaction in the pudendal block group. [17,18] However, the pharmacological interventions used to reduce post-operative opioid vary widely and the certainty of the evidence was unclear. In the trial by Abramov [4], the authors used hydromorphone and ketorolac, while Rouholamin used Morphine consumption [3], Ismail used pethidine and paracetamol [17] and Khalil reported Tramadol and Ketoprofen. [18] Therefore, we categorized these into sub-groups of opioids and NSAIDs and performed a sensitivity analysis to assess the overall effect size of the both groups. We found an overall effectiveness in favour of the PNB group compared to the control. Across all studies, postoperative nausea and vomiting was reportedly higher in the control group compared to the PNB group. [3,4,17,18] Patient satisfaction was reported to be significantly better in the PNB group than control. [17,18] Surgeon satisfaction was reported as higher in the PNB group compared to the control, but only one RCT provided results

for this outcome and data was meta-analysed.^[18] However, when we pooled this data in a meta-analysis, we did not find any significant difference in effect estimates. Similarly, for return to normal activity, non-statistical improvement was reported by individual trials.^[17, 18] However, overall there was significant heterogeneity between studies and no evidence of a difference in favour of quicker return to normal activity between the PNB and control arms.

Some of our results were similar to reports provided by previous studies^[16,37] that investigated the use of PNB to reduce the postoperative pain scores and analgesic requirement, but contradictory to other reports^[24]. In a trial^[16] that evaluated the analgesic effect of 0.25% Bupivacaine on gluteal pain among patients who underwent sacrospinous ligament colpopexy. The authors^[16] did not report reduced postoperative pain scores but found significant reduction in pain medication requirement after surgery.^[16] In another study authors assessed the effect of extended release bupivacaine also known as liposomal bupivacaine for reducing postoperative pain after robotic colpopexy and posterior repair.^[24] The results showed no improvement in postoperative pain or decrease requirements for medications. However, this might be due to higher nerve involvement by robotic use.^[24] In 2009, Long and colleagues conducted a clinical trial among women undergoing vaginal surgery who were given 0.50% of bupivacaine using a paracervical approach as a pre-emptive analgesic. The authors reported statistically significant improvement in postoperative pain scores and requirement for narcotics.^[37]

Limitations.

These results suggest that pre-emptive via PNB might be beneficial for the management of postoperative pain and for reducing analgesic requirement, but its clinical importance remains unclear.^[18] Expected disadvantages of pudendal nerve block are incomplete analgesia, systemic toxicity and hematoma formation^[3,4,17,18, 32] However, these outcomes were not evaluated by studies included in this review and were under-powered to adequately assess these outcomes.

This study was designed using a comprehensive search strategy to reduce the possibility of publication bias. However, studies might have been missed that were not indexed in the databases searched for this review. The methodological quality of most studies were poor due to inadequate designs such as using opaque envelopes for allocation concealment and poor blinding techniques common in single center studies.^[25] Furthermore, we took a broad approach when justifying generalizability of the study populations during the process of performing the GRADE assessment for outcomes. Although substantial heterogeneity was identified between studies, we did not downgrade studies for indirectness, which may have introduced uncertainty in the sample estimates and bias in our results.

The evidence used to synthesize findings for this review only included RCTs which represent the highest level of evidence. However, we were limited by the nature of the information provided in these reports that showed poor reporting standards. Three^[4,17,18] out of four^[3,4,17,18] studies did not report complete study procedures or data in their published paper. Data were missing or wrongly reported, which questions the accuracy of the findings used to synthesize evidence in this review. We were limited by the quantity and quality of studies identified and could not explore the effect of other factors such as a subgroup analysis for the indication of type of approach; perineal or vaginal surgery; time of pain assessment; pudendal block approach (with or without simulator guide and/or anesthetic solution (% of Bupivacaine or mixed). Although, we planned to perform sensitivity analyses to examine

the effect of risk of bias on the results in relation to adequate allocation concealment and sources of missing data. There were insufficient trials to undertake these analyses.

Conclusion

This review found some evidence that pre-emptive pudendal blocks for perineal or vaginal surgeries, might be beneficial for reducing postoperative pain, decreasing use of opioids and NSAIDs as well as related side effects. Further research is needed to confirm these conclusions using larger, appropriately designed, double blind, randomized controlled trials that adequately assess and report clinically relevant, objective as well as subjective outcome measures.

Abbreviations

CENTRAL - Cochrane Central Register of Controlled Trials database

CI - [Confidence interval](#)

GRADE - Grading of Recommendations, Assessment, Development and Evaluations

I^2 - Inconsistency test

MD - Mean differences

MeSH - Medical Subject Headings

NSAIDs—Non-steroidal anti-inflammatory drugs

OR - Odds ratio

POP - Pelvic organ prolapse

PNB - Pudendal nerve block.

PRISMA - Preferred Reporting Items for Systematic Reviews and Meta-Analyses

PROSPERO - International prospective register of systematic reviews

RCTs - Randomized controlled trials

RR - Relative risk

RR - Risk ratio

SD - Standard deviation

SMD - Standardized mean differences

SoF—Summary of findings

VAS—Visual analogue scale

Declarations

-Ethics approval and consent to participate

"Not applicable"

-Consent for publication

"Not applicable"

-Availability of data and material

"Not applicable". Data analysed during the conduct of this systematic review were in the public domain and available within or from the corresponding authors of original articles. All supplementary materials have been provided as Appendices.

-Competing interests

The authors declare that they have no conflict of interests.

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MR, DA and AA developed, refined and designed the research topic.

JT and MR developed the search strategy for the systematic review, carried out data extraction, quality assessment, data synthesis and interpretation of study results.

DA and AA provided methodological and content area expertise during data synthesis of initial reports.

MR, JT, DA and AA contributed to critically appraising the evidence, writing and refining drafts until final approved version was produced.

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Tables

Table 1: Characteristics of the included studies

Study	Participants	Diagnosis for procedure and surgical approach	Specifics of the intervention(s)	Outcomes	Results
Abramov 2005 (4)	IG: GA+PNB n = 51 Sample loss = 2 Mean age: 61.2 (SD 14) yrs Median Parity: 3 (0-7) BMI (kg/m²): 28.9 (SD 14) PPOP Stage: II: 33 (66) III: 12 (24) IV: 6 (12)	Inclusion criteria: -Women undergoing transvaginal pelvic reconstructive surgery under general anesthesia. -ASA physical status I-II Exclusion criteria: -Intolerance to local anesthetic agents or narcotics -Coagulation disorders -ASA physical status of more than II -History of a major psychiatric disorder chronic pain syndromes, substance abuse -Current opioid use or planned procedure for urinary incontinence	Intervention, PNB: Pre-emptive pudendal nerve blockade with 10 mL of 0.25% bupivacaine bilaterally. Procedure: After general anesthetic induction, each patient received a 10-mL pudendal nerve block injection on each side as per pudendal block protocol. After 2 hrs, if surgery was still in progress, an additional 5-mL pudendal nerve block was administered on each side. Co-interventions: Analgesic requirements either intravenous hydromorphone or ketorolac consumption. Thirty-two participants (63%) from the bupivacaine group and 30 participants (59%) from the saline group received a second pudendal block injection due to prolongation of their surgery beyond 2 hrs.	1- VAS 2-Additional post-operative analgesic requirements at 3, 7, 18, and 24 hrs after surgery 3-Medical and surgical complications 4-Length of hospital stay	- The mean change in the VAS (10cm) pain scores showed no significant improvement in the intervention group compared to the control group -No significant difference between the 2 groups was found for consumption of intravenous hydromorphone (1 mg), additional boluses of hydromorphone (15 mg), ketorolac (1 mg) or analgesics (mg/hr) at all assessment times. -No significant differences in hospital stay (39.6 hrs versus 37.3 hrs) or complication rates (nausea/vomiting, itching or respiratory depression) were found between groups.

Study	Participants	Diagnosis for procedure and surgical approach	Specifics of the intervention(s)	Outcomes	Results
	CG: GA+ normal saline n = 51 Sample loss = 2 Mean age: 58.6 (SD 13) yrs Median Parity: 3(0-10) BMI (kg/m ²): 29.2 (SD 16) PPOP Stage: II: 34 (68) III: 11 (22) IV: 6 (12)		Control: Pre-emptive pudendal nerve blockade with 10 mL of normal saline (0.9%) bilaterally. Co-interventions: Same as in IG		
Ismail 2012 (17)	IG: GA+PNB n = 65 Sample loss = 0 Mean age: 34.5 (SD 5.9) yrs. Mean Parity: 4.6 (SD 2.1) BMI (kg/m ²): <25: 35 (53.85) 25-30: 24 (36.92) >30: 6 (9.23)	Inclusion criteria: -Women scheduled for posterior colpoperineorrhaphy -ASA physical status I-II -Age between 25 and 45 yrs Exclusion criteria: -Intolerance to local anesthetic agents or narcotics -Coagulation disorders -ASA physical status of more than II -History of a major psychiatric disorder, chronic pain syndrome or substance abuse -Current opioid use. Procedure: General anesthesia combined with pre-emptive analgesia by bilateral nerve stimulator-guided pudendal nerve	Intervention, PNB: After general anesthesia, pre-emptive analgesia by bilateral nerve stimulator-guided pudendal nerve block (group II) with 10 mL of 0.25% bupivacaine to each side was performed using transperineal approach. Co-interventions: -Analgesics was provided after surgery (transvaginal approach) during hospital stay. Pethidine (1 mg/kg for 24 hr) for participants with VAS score of > 50mm and paracetamol IV infusion (mg/24 hr) for participants with VAS score of 30-50mm to max of 1g/6hrs. for participants with VAS score <30mm no supplemental analgesics was administered.	1- 24hrs VAS (0-100mm) 2-Post-op analgesic consumption 3-Adverse effects of pudendal nerve block 4-Medical and surgical complications 5-Length of hospital stay 6-Resumption of normal activities measured @ clinic day 4, 8 and 14 after discharge 7- Overall patient satisfaction score (1-4-point verbal scale ranging from very satisfied to very dissatisfied) with analgesia	-Average postoperative VAS pain scores (p <0.0001) -IM pethidine and IV paracetamol consumption (mg/24hr) were significantly lower in the PNB group compared to the control (p <0.0001) -PNB group showed a shorter recovery room stay (hr) compared to the control group (p < 0.0001) -No significant difference was observed for post-operative nausea (p=0.38), vomiting (p=0.40) and urinary

Study	Participants	Diagnosis for procedure and surgical approach	Specifics of the intervention(s)	Outcomes	Results
	CG: GA only n = 65 Sample loss = 0 Mean age: 33.1 (SD 6.2) yrs. Mean parity: 4.3 (SD 2.0) BMI (kg/m ²): <25: 32 (49.23) 25-30: 26 (40.0) >30: 7 (10.77)	block with 10 mL of 0.25% bupivacaine.	General anesthesia alone Co-interventions: Same as in IG	(24 hrs after operation)	retention (p=0.09) -PNB group showed higher discharge rates (days) (p<0.0001) and quicker return to normal activities (days) compared with the control group (p < 0.0001) -Overall patient satisfaction score with analgesia and pain relief was significantly higher in the PNB group compared to control group (p < 0.0001).
Rouholamin 2015 (3)	IG: Spinal anaesthesia + bupivacaine 0.25% n = 30 Sample loss = NR Mean age: 41.9 (SD 7.1) yrs	Inclusion criteria: -Women undergoing anterior posterior repair under spinal anaesthesia performed using the same technique and by the same Gynecologist. -ASA status I and II Exclusion criteria: -No history of allergy to local anesthetic agents and narcotics -No history of clotting problems -No history of major psychological disorders -No history of chronic pain syndrome -Lack of long-term use of painkillers -No recent use of opioids -Lack of diabetes mellitus type 1 and 2 -Need to change the type of anaesthesia during surgery (due	Intervention, PNB: The spinal block was done with 3 cc bupivacaine 0.25% in 10-15s. -Stimulator-guided pudendal nerve block. The solution was injected in the pudendal nerve passage way by nerve stimulator in both groups at the same period of anesthesia. Co-interventions: -Both groups received the same post-op. care of additional IV bolus of morphine 0.08 mg/kg until VAS was <3 and monitoring for up to 48hrs.	1-VAS from 0-48hrs 2-SBP and DBP (mmHg) from 0-48hrs 3-Heart rate and Respiratory rate (bpm) from 0-48hrs 4- Total analgesic Pain relief medication bolus (0.08 mg/kg morphine) recorded at 2, 4, 6, 12, 24 and 48 hrs after surgery 5- Nausea and vomiting managed with metoclopramide (0.15 mg/kg). 6-Complication rate at 48-hrs post-operatively 7-Sedation scores 0-48hrs post-operation	-Significant differences in changes in pain intensity at rest with higher pain levels (hrs) in the control group compared with the PNB group (p=0.003) and while standing (p=0.021). No significant difference in change was found in sitting position (p=0.34) -Mean change within and between groups in systolic (p=0.2) and diastolic blood pressure (p=0.15) were not different in the intervention and control arms. -Mean changes in HR (P=0.47) and RR (P=0.81) were not

Study	Participants	Diagnosis for procedure and surgical approach	Specifics of the intervention(s)	Outcomes	Results
	CG: spinal anaesthesia + 0.3 cc/kg normal saline n = 30 Sample loss = NR Mean age: 41.6 (SD 10) yrs	to prolongation of the operation or failure to block). Procedure: Both groups received the same pre-operative care and spinal anaesthesia.	Control: The block was done with 0.3 cc/kg normal saline for the control group was injected in the pudendal nerve passage way using a nerve simulator at the same period of anaesthesia. Co-interventions: same as in IG		significantly different between groups. -Morphine consumption was only significantly higher in the control group at 4 and 12 hrs after surgery. -No difference was identified in the frequency of incidence of nausea and consumption of metoclopramide. -At 48hrs post-operatively, no difference in complication rates were identified between the PNB and control groups -No significant differences ($p = 0.41$) in between group mean sedation scores from 0-48hrs was identified

Study	Participants	Diagnosis for procedure and surgical approach	Specifics of the intervention(s)	Outcomes	Results
Khalil 2016 (18)	IG: GA+PNB n = 28 Sample loss = 0 Mean age: 43.4 (SD 12.7) yrs Weight: 70.2 (13.2) kg Height: 158.4 (7.9) cm Stages of pelvic organ prolapse: I- 11(39.3%) II- 10 (35.7%) III- 5 (17.9%) IV- 2 (7.1%)	Inclusion criteria: -Participant between 20 and 53 yrs -Scheduled to undergo AP colporrhaphy due to cystocele. Exclusion criteria: -Participants who are allergic to any of the local anesthetics. -Have distorted anatomy due to previous surgery such as episiotomy, -Have any concurrent surgery -Refused to participate in the study.	Intervention, PNB: Every 30 mL of the local anesthetic mixture contained 2% lidocaine 10 mL, 2% lidocaine 10 mL with adrenaline 5 µg/mL, 0.5% bupivacaine 9.5 mL, and clonidine 0.5 mg (75 µg). A 22G 10-cm nerve stimulator needle was used as per protocol. Co-interventions: Intravenous analgesics of paracetamol or ketoprofen once/day for VAS 3-4; tramadol hydrochloride 50-100 mg every 4-6 hrs, max. 400 mg/day for VAS scores 4-5; morphine (0.1-0.2 mg/kg) for VAS scores >5. Participants in stages I and II required propofol sedation and stages III and IV required propofol and sevoflurane.	1- VAS at (6, 12, 24, 36, and 48 hrs). 2-Pain relief medication bolus (morphine) 4- MAP 5-Post operative nausea and vomiting PONV 6- Return to normal activity 7-Patient satisfaction 8-Surgeon satisfaction 9-Medical or surgical complications	-Significant difference in average postoperative pain scores over 48 hrs (P =0.015). -Total analgesic consumption (ketoprofen and tramadol) was lower in the PNB group during the first 48 hrs. -Significantly lower MAP in the PNB group compared with GA group during (87.6 vs 99.9, P =.002) and at the end of operation (91.1 vs 102.2, P < .0001). -PONV was minimal in the PNB group compared with the GA group (3.6% vs 41.4%). -Return to normal daily activity was significantly (P = .015) shorter in the PNB group compared with GA group (3.6 vs 12.2 days). -Patient satisfaction was significantly (P = .006) greater in the PNB group. -Surgeons who performed the operation with the PNB group were significantly (P = .005) more satisfied than those from the GA group.

Study	Participants	Diagnosis for procedure and surgical approach	Specifics of the intervention(s)	Outcomes	Results
	CG: GA alone n = 29 Sample loss = 0 Mean age: 40.8 (SD 10.2) yrs Weight: 75.7 (12.9) kg Height: 158.5 (6.7) cm Stage of pelvic organ prolapse: I- 12 (41.4%) II- 10 (34.5%) III- 6 (20.7%) IV- 1 (3.4%)		General anesthesia alone. Co-intervention same as in IG.		-None of participants had hematoma, infection, or persistent paraesthesia secondary to the nerve blocks

Footnotes: IG-Intervention group; GA-General anesthesia; PNB-Pudendal nerve block; yrs-years; BMI-basal metabolic index; kg/m²-kilogram per square metre; PPOP Stage - Preoperative pelvic organ prolapse; ml - Milli-litres; %-percentage; cm-centimetres; VAS-visual analog scale; F - female; Times; p-p-value; CG-Control group; hr-Hour; / - Per; Hz-Hertz; mA-micro-ampoules; IV-intravenous; IM-intramuscular; mm-millimetres; post-op-Post-operative; NR-not reported; cc-cubic centimeter; SBP - systolic blood pressure; DBP-diastolic blood pressure; bpm - beats per minute; MAP - Mean arterial blood pressure; mmHg - millilitres per mercury; PONV-post-operative nausea and vomiting

Table 2: Risk of bias ratings for randomised studies

Abramov 2005 (4)	Ismail 2012 (17)	Rouholamin 2015 (3)	Khalil 2016 (18)	Trial characteristics	Classification	
					û	High risk of bias
					?	Unclear
					ü	Low risk of bias
ü	ü	ü	ü	Random sequence generation (selection bias)		
ü	ü	?	ü	Allocation concealment		
ü	ü	ü	ü	Blinding (performance bias and detection bias): participants		
ü	?	û	û	Blinding (performance bias and detection bias): surgeons and anaesthesiologist		
ü	?	û	ü	Blinding (performance bias and detection bias): outcome assessors		
ü	ü	ü	ü	Incomplete outcome data (attrition bias): Were dropouts reported and equal between groups?		
ü	ü	ü	ü	Incomplete outcome data (attrition bias): Were all randomised participants analysed in the group to which they were allocated?		
ü	ü	ü	ü	Selective reporting (reporting bias)		
ü	ü	ü	ü	Groups similar at baseline		
ü	ü	ü	ü	Co-interventions		
ü	ü	ü	ü	Similar outcome timing		
Low	Unclear	Unclear	Low	Overall risk of bias		

Table 3: Summary of findings table – GRADE levels of evidence

Outcome	Participants	Design (studies)	RoB	Inconsistency	Indirectness	Imprecision	Certainty
Post-op VAS scores	349	4 RCTs	High	Poor	Good	Poor	Very Low*
Total analgesic consumption	289	3 RCTs	Low	Poor	Good	Poor	Low*
Postoperative nausea and vomiting	349	4 RCTs	High	Good	Good	Poor	Low
Intravenous hydromorphone	102	1 RCT	Low	NA	Good	Poor	Low□
Return to activity (days)	187	2 RCTs	High	Good	Good	Poor	Low
Total length of hospital stay (hours)	232	2 RCTs	High	Poor	Good	Poor	Very Low
Surgeon satisfaction with procedure	57	1 RCT	Unclear	NA	Good	Poor	Very Low□
Patient satisfaction with management	187	2 RCTs	Low	Good	Good	Poor	Low#
Other Adverse events (requirement for additional intraoperative sedation)	57	1 RCT	Low	NA	Good	Poor	Low□
Incomplete analgesia	Not measured	-	-	-	-	-	No evidence
Hematoma formation	Not measured	-	-	-	-	-	No evidence
Cost-effectiveness	Not measured	-	-	-	-	-	No evidence
Quality of life	Not measured	-	-	-	-	-	No evidence

RoB – Risk of bias; *Complete data from one study unavailable; NA- Not applicable; Downgraded for being a single study□; Downgraded for being reporting bias#

Table 4: Primary outcome of included studies – VAS

Outcome	Arm\Study	Abramov 2005 ⁽⁴⁾	Ismail 2012 ⁽¹⁷⁾	Rouholamin 2015 ⁽³⁾ #	Khalil 2016 ⁽¹⁸⁾
Average postoperative VAS pain scores (mm/cm)	PNB	(VAS: 0-10 cm) Median (range) 1 hr: 4(0-10) 3 hrs: 3(0-10) 5 hrs: 3(0-9) 7 hrs: 2(0-9) 18 hrs: 3(0-9) 24 hrs: 3(0-10)	24 hrs post- operation (VAS: 0-100 mm) 23.5 (SD 7.4)*	1 hr 2 hrs 4 hrs 6 hrs 12 hrs 24 hrs 48 hrs	(VAS: 0-10 cm) - <u>Within first day:</u> 2.1 (SD 1.0) - <u>Within the second day:</u> 1.5 (SD 1.2)*
	Control	1 hr: 5(0-10) 3 hrs: 4(0-8) 5 hrs: 4(0-8) 7 hrs: 3(0-8) 18 hrs: 4(0-9) 24 hrs: 3(0-8)	51.1± (SD 13.2) - - -	1 hr 2 hrs 4 hrs 6 hrs 12 hrs 24 hrs 48 hrs	<u>Within first day:</u> 2.9 (SD 0.9) - - <u>Within the second day:</u> 2.7 (SD 1.8)

Results for this study is unavailable, authors were contacted for complete data with no reply; VAS-visual analog scale; mm-millimetre; cm-centimetre; PNB-Pudendal nerve block; hr- hour; SD-standard deviation; p-p-value; significant difference from pre-test; *p<0.05; **p<0.001;

Table 5a: Secondary outcome measures reported as means

Study	Outcome	Time point	PNB	Control
Abramov (2005) ⁽⁴⁾	1 mg bolus of Intravenous hydromorphone consumed [Mean (SD)]	0-3 hrs	1.84 (1.15)	1.77 (1.13)
		4-7 hrs	1.19 (0.97)	1.20 (0.83)
		8-18 hrs	2.89 (2.59)	2.35 (2.77)
		Total hrs	5.92 (3.91)	5.32 (2.48)
	Total hydrocodone (500 mg /24hr) [Mean (SD)]	Every 4hrs	10.6 (9)	12.7 (11)
	Total ibuprofen (600 mg /24hr) [Mean (SD)]	Every 6 hrs	630 (779)	762 (716)
	Total hospital stay (hr) [Mean (SD)]	-	39.6 (14)	37.3 (13)
Ismail (2012) (17)	Total pethidine IM (mg/24 hr) [Mean (SD)]	24 hrs	239.4 (30.7)	278.3 (45.9)
	Total paracetamol IV infusion (mg/24 hr) [Mean (SD)]	24 hrs	2.0 (0.5)	2.6 (0.4)
	Overall patient satisfaction score with analgesia 24 hr after operation) [Mean (SD)]	24 hrs	3.4 (0.6)	2.8 (0.7)
	Total hospital stay (hr) [Mean (SD)]	-	25.86 (2.68)	28.38 (3.24)
	Resumption of normal activities (days) [Mean (SD)]	4-14 days	7.71 (1.1)	8.67 (0.9)
Khalil (2016) (18)	<i>Analgesic consumption [Mean (SD)]</i>			
	Ketoprofen	First 48 hrs	232.1 (190.6)	346.4 (129.1)
	Tramadol	First 48 hrs	35.5 (54.7)	96.6 (109.7)
	Return to normal activity (days)	-	3.6 (3.1)**	12.2 (2.9)

PNB-Pudendal nerve block; SD - standard deviation; hr- hour; mg-milligram; VAS-visual analog scale; IM-intramuscular; IV-intravenous;

*p<0.05; **p<0.01; ***. p<0.001

Table 5b: Secondary outcome measures reported in proportions

Study	Outcome		PNB (n, %)	Control (n, %)
Abramov 2005 ⁽⁴⁾	Additional boluses of hydromorphone (1 mg)		9 (18)	9 (18)
	Additional boluses of ketoralac (15 mg)		6 (12)	4 (8)
	<i>Post-operative adverse effects of hydromorphone</i>			
	Nausea/vomiting		2(4)	3(6)
	Itching		0 (0)	2(4)
	Respiratory distress		0 (0)	0 (0)
Ismail 2012 (17)	Nausea		5 (7.69)	8 (12.31)
	Vomiting		2 (3.07)	4 (6.15)
	Urine retention		1 (1.53)	5 (7.69)
Rouholamin 2015 ⁽³⁾	Incidence of consumption of Morphine	Time point	PNB (n, %)	Control (n, %)
		1 hr - Yes	2 (6.9)	6 (20.7%)
		No	27 (93.1)	23 (79.3)
		2 hr (Yes)	6 (20.7)	7 (24.1)
		No	23 (79.3)	22 (75.9)
		4 hr (Yes)	6 (20.7)	15 (51.7)
		No	23 (79.3)	14 (48.3)
		6 hr (Yes)	16 (55.2)	14 (48.3)
		No	13 (44.8)	15 (51.7)
		12 hr (Yes)	11 (37.9)*	21 (72.4)*
		No	18 (62.1)	8 (27.6)
		24 hr (Yes)	6 (20.7)	10 (34.5)
		No	23 (79.3)	19 (65.5)
		48 hr (Yes)	3 (10.3)	5 (17.2)
		No	26 (89.7)	24 (82.8)
	Incidence of nausea with consumption of Metoclopramid, mg/kg	1 hr - Yes	1 (3.4)	3 (10.3)
		No	28 (96.6)	26 (89.7)
		2 hr (Yes)	0 (0.0)	2 (6.9)
		No	29 (100)	27 (93.1)
		4 hr (Yes)	1 (3.4)	1 (3.4)
		No	28 (96.6)	28 (96.6)
		6 hr (Yes)	0 (0.0)	0 (0.0)
		No	29 (100)	29 (100)
		12 hr (Yes)	1 (3.4)	3 (10.3)
		No	28 (96.6)	26 (89.7)
		24 hr (Yes)	0 (0.0)	2 (6.9)

Study	Outcome		PNB (n, %)	Control (n, %)
		No	29 (100)	27 (93.1)
		48 hr (Yes)	0 (0.0)	1 (3.4)
		No	29 (100)	28 (96.6)
Khalil (2016) ⁽¹⁸⁾	Incidence of PONV		1 (3.6)*	12 (41.4)
	<i>Patient satisfaction</i>			
	Satisfied		20 (71.4)	8 (27.8)
	Partially Satisfied		4 (14.3)	2 (6.9)
	Unsatisfied		4 (14.3) **	19 (65.5)
	<i>Surgeon satisfaction</i>			
	Satisfied		23 (82.1)	10 (34.5)
	Partially Satisfied		1 (3.6)	0 (0.0)
	Unsatisfied		4 (14.3) **	19 (65.5)
	<i>Requirement for additional intraoperative sedation in PNB group (Yes/No)</i>			
	Stage of prolapse		Participants not requiring additional intraoperative sedation / patient requiring additional sedation	NA
	I		Yes - 9 (81.8)	-
			No - Propofol (50 mg) - 2 (18.0)	
	II		Yes - 6 (60.0)	-
			No - Propofol (50 mg) - 4 (40.0)	
	III		Yes - 0 (0.0)	-
			No - Propofol (50 mg) & sevoflurane (0.8) - 2 (40.0)	
	III		Yes - 0 (0.0)	-
			No - Propofol (50 mg) & sevoflurane (2.5) - 3 (60.0)	
	IV		Yes - 0 (0.0)	-
			No - Propofol (50 mg) & sevoflurane (2.5) - 2 (100.0)	

PNB-Pudendal nerve block; n-number; %-percentage; mg-milligram; /-per; kg-kilogram; hr-hour; *p<0.05; **p<0.01; ***: p<0.001; PONV-post-operative nausea and vomiting; NA-Not applicable

Figures

PRISMA Flow Diagram

Figure 1

Showing study selection process for systematic review of pudendal nerve block using bupivacaine

Figure 2

: Forest plot showing subgroup standardized mean differences in additional analgesic requirements between the intervention and control arms. SD, standard deviation; CI, confidence interval; I², inconsistency test; PNB, Pudendal nerve block.

Figure 3

Forest plot showing sensitivity analysis for subgroup standardized mean differences in additional analgesic requirements between the intervention and control arms. SD, standard deviation; CI, confidence interval; I², inconsistency test; PNB, Pudendal nerve block.

Figure 4

Forest plot showing relative risk in adverse events of post-operative nausea and vomiting between the PNB and control arms. RR; Risk ratio, CI, confidence interval; I², inconsistency test; PNB, Pudendal nerve block.

Figure 5

Forest plot showing mean differences in length of hospital stay between the intervention, PNB and control arms. SD, standard deviation; CI, confidence interval; I², inconsistency test; PNB, Pudendal nerve block.